Meta-Stereotypes' Impact on Working Memory Capacity

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Abstract: Meta-stereotypes are the inherent beliefs that in-group members hold about the evaluations that out-group members might have about the in-group. Since there are evaluations with both positive and negative valences, there are meta-stereotypes with both positive and negative valences. These two types of meta-stereotypes may have different effects based on the principles of reciprocity and non-reciprocity. However, in research on the impact of meta-stereotypes on working memory capacity, researchers have only found the choking effect of activating positive meta-stereotypes among rural college students. Similarly, in conditions that activate negative meta-stereotypes, only the threat effect of activating negative meta-stereotypes has been found among the elderly and migrant children groups. This may be due to previous studies primarily focusing on groups that hold more negative meta-stereotypes. Therefore, future research can be conducted across multiple groups. Additionally, the effects of activating meta-stereotypes are also influenced by the type of meta-stereotypes being activated. In the future, more specific and effective ways of activating meta-stereotypes can be developed to distinguish the impact of different types of meta-stereotypes on working memory capacity.

1 INTRODUCTION

Meta-stereotype is a concept that belongs to the realm of meta-perception, first introduced by Vorauer and colleagues in 1998 (Vorauer et al., 1998). Meta-stereotype refers to an individual's beliefs about the stereotypes that out-group members hold about their own group (in-group). These meta-stereotypes can vary depending on the specific out-group individuals (Dong et al., 2023). Due to the fact that evaluations from out-groups are often composed of a series of judgments, which are themselves made up of a series of negative or positive traits, meta-stereotypes, which involve different valences of traits, also have positive or negative valences (Dong et al., 2022). Previous research has shown that both positive and negative meta-stereotypes can lead to positive or negative outcomes, meaning that meta-stereotypes of the same valence may result in different effects. The reason why the same meta-stereotype can lead to different effects is due to adherence to two different principles, namely the "reciprocal principle" and the "non-reciprocal principle" (Dong et al., 2022, He & Liang, 2008). The reciprocal principle refers to effects that correspond to the valence of meta-stereotypes. Negative meta-stereotypes that lead to negative impacts can produce a threat effect, while the activation of positive meta-stereotypes that lead to positive impacts can produce a boost effect. On the other hand, the non-reciprocal principle refers to the activation of meta-stereotypes that produce effects that do not conform to their inherent valence. That is, when positive stereotypes are activated, they may instead produce a negative effect, known as the choke effect; or when negative meta-stereotypes are activated, they may produce a positive effect, known as the backlash effect (Dong et al., 2022).

Previous studies have largely discussed the meta-stereotypes' activation of in terms of intergroup relations and its impact on individuals in social interactions. However, recent study has found that the meta-stereotypes' activation not only affects people's social interactions but also influences their cognitive performance. Working memory is the system the brain uses to temporarily store and manipulate information during complex cognitive tasks, and it is often used as a representative task to explain individual cognitive differences. Therefore, studying the impact of activated meta-stereotypes on working memory is an important way to investigate the meta-stereotypes' cognitive effects. This article mainly introduces the impact of activating positive and negative meta-stereotypes on working memory capacity through several recent studies, and proposes the limitations of current research and future research directions (He et al., 2024).

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2 POSITIVE META-STEREOTYPE'S EFFECTS ON WORKING MEMORY CAPACITY

2.1 Effects on Working Memory Capacity

Based on the feedback principle mentioned earlier, the effect produced by positive meta-stereotypes is called the enhancement effect. Since positive meta-stereotypes reflect the positive evaluation of the in-group by the out-group, they themselves contain many positive traits. Therefore, when individuals feel that they are viewed positively by the out-group, it not only increases positive feelings but also encourages individuals to respond to the out-group in a positive manner (Dong et al., 2022). Previous studies on positive meta-stereotypes have mainly focused on exploring the social psychological effects of positive meta-stereotypes, and there are more researches on positive meta-stereotypes than that on negative meta-stereotypes (He et al., 2024). For example, research on the impact of positive meta-stereotypes on intergroup emotions and attitudes, but there is a lack of research on the impact of positive meta-stereotypes on cognitive functions. Currently, there is a scarcity of related literature (Dong et al., 2023, Dong et al., 2022).

The impact of the activation of positive meta-stereotypes is mainly manifested in two effects: one is the enhancement effect. Previous research has found that when individuals feel positively regarded by the out-group, they increase positive feelings and reciprocate positively towards the out-group; the other is the choking effect, which refers to the situation where individuals, aware of the high expectations the out-group has for their own group, feel increased pressure, become overly self-focused, and even worry and doubt themselves (Dong et al., 2022). However, research on the activation of positive meta-stereotypes and its impact on working memory is relatively scarce. In 2023, Chinese scholar using rural college students as subjects, conducted three experiments to investigate the effects of activating positive meta-stereotypes on working memory and the mechanisms behind it (Dong et al., 2023, Belletier et al., 2015).

Researchers activated positive meta-stereotypes by adopting the method used by Owuamalam and Zagefka to manipulate the activation of meta-stereotypes (Owuamalam & Zagefka, 2011). They asked participants to list the positive impressions that out-group members hold about in-group members, and also included a control group that listed issues unrelated to both the in-group and out-group. After the meta-stereotype activation manipulation, the effectiveness of the meta-stereotype activation was tested by asking participants to rate their perception of the general views that out-group members have towards the in-group members (Dong et al., 2023). In the measurement of working memory tasks, researchers used the N-back task as a measurement of working memory. The N-back task asks to participants responding to whether the currently presented stimulus is the same as the one that appeared N positions prior, based on a series of stimuli and their order as required by the task. The N-back task can be used to assess various aspects of working memory, including the ability to update information, maintain information, and maintain information in the face of interference. This task is very useful in studying working memory, attention control, cognitive training, and brain function and plasticity. In this study, researchers used the 2-back task as a difficulty working memory task and the 1-back task as a simple working memory task. Theoretically, the 2-back task consumes more cognitive resource space compared to the 1-back task, thus presenting participants with greater challenges when performing the 2-back task. The study used the activation of positive meta-stereotypes and the difficulty of working memory tasks as independent variables and found that under high difficulty tasks, individuals with activated positive meta-stereotypes had significantly lower accuracy in working memory tasks compared to the control group, and their response times were longer than those in the control group. However, on low difficulty tasks, there was no significant difference in working memory performance between participants with activated positive meta-stereotypes and those in the control group. This indicates that the activation of positive meta-stereotypes has a choking effect on participants in high difficulty working memory tasks (Dong et al., 2023).

2.2 The Mechanism by Which Positive Meta-Stereotypes Affect Working Memory

Cognitive Resource Theory offers a highly explanatory power for the choking effect induced by the activation of positive meta-stereotypes. Research indicates that when individuals are performing tasks requiring executive control (such as the N-back task or Reading span task), the activation of positive

meta-stereotype can divert their attention like monitoring observation, shifting some cognitive resources towards awareness of the monitor or meta-stereotype activation, then reducing the cognitive resources allocated to task execution (Belletier et al., 2015). This shift in attention is particularly evident in individuals with high working memory capacity (WMC), as they are more capable of simultaneously processing both the task and the presence of the monitor, making them more susceptible to attentional conflict and distraction. In high WMC individuals, this reallocation of resources leads to a decline in executive control, manifesting as poorer performance on tasks that demand quick and accurate responses, known as the choking effect. This aligns with Cognitive Resource Theory, which posits that under limited resources, excessive focus on one task may come at the expense of another's performance, as available cognitive resources are competitively directed towards stimulused positive meta-stereotype (Belletier et al., 2015, Tagler, 2012).

Li's research also found the mediator, approach motivation and the moderator core self-evaluation. Which mediates or moderates the positive meta-stereotypes's choking effect on working memory. Using the Bootstrap method in SPSS to evaluate the mediating effect of approach motivation, it was shown that approach motivation plays a partial mediating role in the influence of activated positive meta-stereotypes on working memory (Li et al., 2021). Further analysis revealed that when positive meta-stereotypes had been activated, participants exhibit stronger approach motivation, which in turn leads to a decrease in the accuracy of high-difficulty working memory tasks. This occurs because the activation of positive meta-stereotypes creates a goal and expectation for individuals, prompting them to enhance their approach motivation to prove themselves. The reason for the reduced allocation of cognitive resources to working memory is partly due to participants investing excessive approach motivation, which consequently lowers the accuracy of working memory tasks (Dong et al., 2023). The study also explored the moderating role of core self-evaluations (CSE) in the choking effect on working memory tasks caused by the activation of positive meta-stereotypes. Core self-evaluations refer to an individual's fundamental assessment of their own abilities, worth, and self-efficacy. Using the Process Model 5 in Model Templates for PROCESS for SPSS and SAS to analyze the moderating effect of CSE, with positive meta-stereotype activation as the independent variable, approach motivation as the mediating variable, and accuracy under high difficulty conditions as the dependent variable, the statistical results indicated that the interaction term between positive meta-stereotype activation and core self-evaluations significantly predicted the accuracy of high difficulty tasks(Li et al., 2021). This demonstrates a significant moderating effect, such that the higher the core self-evaluations, the greater the impact of positive meta-stereotype activation on the accuracy of high difficulty tasks (He et al., 2024, Li et al., 2021).

Currently, most research on the impact of positive meta-stereotypes on working memory has found that positive meta-stereotypes can lead to a choking effect. However, previous studies have pointed out in their discussion sections that the choking effect occurs only in tasks with high cognitive load requirements, while there are no significant differences in low-difficulty tasks. Researchers believe that the choking effect resulting from the activation of positive meta-stereotypes may be due to the selection of individuals who hold fewer positive meta-stereotypes in their daily lives, such as the rural college student population (Li et al., 2021). When positive meta-stereotypes are difficult to retrieve, the process of extracting them may become a source of stress for individuals, potentially triggering a choking effect (Vázquez et al., 2017). Therefore, in future research, it would be beneficial to study groups that inherently hold more positive meta-stereotypes. When such groups have their positive meta-stereotypes activated, will it result in a facilitation effect on working memory, or will a choking effect still be observed? Additionally, for individuals with a greater number of positive meta-stereotypes, will task difficulty influence the impact of activated positive meta-stereotypes on working memory capacity?

3 NEGATIVE META-STEREOTYPE'S EFFECTS ON WORKING MEMORY CAPACITY

3.1 The Effect of Negative Meta-Stereotypes on Working Memory Capacity

According to the feedback and non-feedback principles mentioned in the introduction, the feedback effect of activating negative meta-stereotypes is manifested as a threat effect. That is, individuals who activate negative meta-stereotypes find themselves in a social-psychological predicament, with their

cognition in a state of imbalance, inducing experiences of fear and stress, which in turn lead to negative consequences (Dong et al., 2022). Similarly, activating negative meta-stereotypes does not always lead to negative outcomes; it can also have positive effects, known as the resistance effect of activating negative meta-stereotypes. The resistance effect refers to the situation where, after activating negative meta-stereotypes, individuals perceive the full extent of negative evaluations and may counter these evaluations by engaging in positive behaviors to maintain their group image or prove their capabilities (Dong et al., 2022).

In 2015, Sun investigated whether the working memory capacity of migrant children is affected by negative meta-stereotypes' activation. In the study, the approach employed to elicit negative meta-stereotypes mirrored the technique utilized for positive ones. This entailed prompting participants to verbalize the potential negative perceptions that an outgroup could harbor towards their own ingroup. Concurrently, the control group was tasked with responding to a query concerning the advancement of the nation's scientific and technological progress (He et al., 2024, Sun et al., 2015). The research proceeded to assess working memory capacity through the N-back task, utilizing black solid geometric shapes—circles, triangles, and rectangles—as visual stimuli. The experimental protocol included a 500ms interval for fixation, a period allocated for participant responses, and a subsequent 500ms interval with a blank screen. The tasks were categorized by cognitive demand, with the 0-back, 1-back, and 2-back variants corresponding to low, medium, and high cognitive load, respectively. Furthermore, the study's repeated measures analysis of variance (ANOVA) revealed that the activation of negative meta-stereotypes exerted a substantial influence on children's working memory performance. The analysis also highlighted a significant main effect attributed to the varying levels of task difficulty (Sun et al., 2015). Furthermore, it was observed that participants who engaged with negative meta-stereotypes exhibited poorer performance in working memory exercises across all three tiers of task complexity when contrasted with the control group that maintained a neutral stance (Sun et al., 2015).

Li and colleagues conducted a study in 2021 of how activating negative meta-stereotypes can impact on the working memory of elderly individuals. This was the first study to use the N-back task to examine the effects of activating negative meta-stereotypes on the cognitive performance of elderly adults under different cognitive load tasks, this study also used graphics as stimulus materials (Li et al., 2021). Researchers examined whether it was possible to manipulate the activation of negative meta-stereotypes in the elderly through instructions and the subsequent answers provided by the elderly based on those instructions. Emotional responses when negative meta-stereotypes are triggered were assessed through emotional scores and physiological indicators such as skin conductance and skin temperature. The findings of the study indicated that a substantial disparity existed in the irritability scores between the negative meta-stereotype activation group and the non-irritable group, while there was no significant difference in the scores of other negative emotions. Consequently, the repeated measures ANOVA disclosed that there was no significant interaction effect between the group and the level of task difficulty. However, both the difficulty level and group membership had significant main effects. The research demonstrated that individuals in the group that activated negative meta-stereotypes scored lower on cognitive tasks compared to those in the group without such activation, thereby validating the notion that activating negative meta-stereotypes has a reciprocal impact on cognitive performance. Additionally, the study found that task difficulty did not have a moderating effect on the activation of negative meta-stereotypes (Li et al., 2021). Previous studies have shown that activating negative meta-stereotypes can lead individuals to desire a change in negative evaluations, thereby exhibiting resistance to these negative traits and demonstrating a positive side to improve intergroup relations (Dong et al., 2022). However, there is currently no research on whether activating negative meta-stereotypes might enhance an individual's cognitive abilities, thereby producing a resistance effect.

3.2 The Mechanism of Negative Meta-Stereotypes' Affect Working Memory

Regarding the mechanism of activating negative meta-stereotypes' impact on working memory, the threat effect of activating negative meta-stereotypes can still be explained by the resource limitation theory. The resource limitation theory posits that negative meta-stereotypes trigger physiological stress responses and induce self-monitoring, which consume an individual's cognitive resources, leading to poorer performance on subsequent cognitive tasks (Dong et al., 2022). Studies on the reduction of working memory capacity in the elderly caused by the negative meta-stereotypes' activation suggest that the

threat of negative meta-stereotype activation to cognitive resources may be manifested in two parts. The first is the conflict between the activation of negative meta-stereotypes and self-improvement. This conflict leads to a state of cognitive imbalance, thereby reducing individuals' self-efficacy in task completion and affecting cognitive performance. On the other hand, Li et al. pointed out that for the elderly, negative evaluations from the outgroup may lead to a sense of helplessness. Simultaneously, it raises doubts about their own abilities and threatens their identification with the ingroup, thereby triggering negative emotions that occupy the cognitive resources of the elderly and lead to a decline in individual working memory capacity (Li et al., 2021).

Additionally, Sun's study on the stereotype threat among migrant children, the potential mediating role of intergroup anxiety was explored. intergroup anxiety levels are tested by judging the valence and familiarity of words related to negative meta-stereotypes as well as neutral words. Inserting words related to negative meta-stereotypes and neutral vocabulary into the N-back task, children were asked to evaluate the valence and familiarity of these words to test intergroup anxiety in both the threat and non-threat groups. The findings of the study demonstrated that the level of intergroup anxiety was markedly elevated in the group where negative meta-stereotypes were activated compared to those where they were not, thereby validating the hypothesis that activating negative meta-stereotypes is associated with increased intergroup anxiety. The research further established that intergroup anxiety did not significantly mediate the link between negative meta-stereotype activation and response times in tasks of low and high difficulty. However, at the medium difficulty level, intergroup anxiety was found to fully mediate this relationship. In conclusion, the study determined that intergroup anxiety exerted a partial mediating influence on the impact of activated negative meta-stereotypes on working memory performance (Sun et al., 2015). The threat effect of activating negative meta-stereotypes on a group is a risk situation experienced by disadvantaged groups in social contexts. Diffusing negative emotions and individuals' uncertainty about evaluation can lead to the generation of anxious negative emotions, which in turn result in a decline in cognitive performance. The non-significant mediating role of intergroup anxiety at low cognitive load may be due to the fact that the decline in individual working memory performance is more likely a result of monitoring behaviour triggered by meta-stereotype threat cues. That is, after the negative meta-stereotypes' activation, participants tend to choose more conservative problem-solving strategies rather than the role played by intergroup anxiety. As for the non-significant mediation in high difficulty cognitive tasks, it may be because complex tasks themselves consume a lot of cognitive resources, making the phenomenon of intergroup relations occupying cognitive resources less apparent (Sun et al., 2015). The partial mediating effect found in the study suggests that there may be many possible pathways through which the activation of negative meta-stereotypes occupies cognitive resources. Different mediating variables may play different roles at different levels of difficulty, and further research can focus on the specific impacts and models under different conditions. However, in general, both the activation of positive meta-stereotypes and negative meta-stereotypes can be explained by the resource limitation model in terms of their negative impact on cognitive abilities such as working memory. Whether the activation of positive meta-stereotypes and negative meta-stereotypes can lead to positive effects, namely the feedback effect and the resistance effect, in situations with different meta-stereotypes and the activation of different positive/negative meta-stereotypes, requires further investigation by researchers in a broader range of participant groups.

4 DISCUSSION AND SUGGESTION

4.1 Summery and Discussion

Combining the findings from the aforementioned research, current studies have discovered that the meta-stereotypes' activation at different valences can have a negative impact on an individual's working memory capacity. That is, the positive meta-stereotypes activation leads to a choking-effect on working memory, while the activation of negative meta-stereotypes results in a threat effect on working memory. Researchers believe that the most direct cause of these two effects is that the activation of meta-stereotypes occupies an individual's cognitive resources. According to the resource limitation theory, the total cognitive resources of an individual are limited. Therefore, when meta-stereotypes are activated, the cognitive resources available for working memory tasks decrease, leading to a decline in working memory performance. However, theoretically, based on the feedback theory, the

activation of positive meta-stereotypes can enhance an individual's perception of their in-group, so under conditions where positive meta-stereotypes are activated, it is possible to achieve positive outcomes. The reason why the research results differ from the theory, according to the researchers, is due to the selection of impoverished college students as the subject group in the study. Such a subject group inherently holds more negative impressions, which leads to a contradiction between self-perception and meta-stereotypes, thus exhibiting a choking effect. Similarly, when studying the impact of negative meta-stereotypes on working memory capacity, individuals who hold more negative meta-stereotypes were selected, such as the elderly and migrant children.

In the study, regarding the activation of meta-stereotypes, the research mentioned in this article all employed implicit activation methods, which required participants to spontaneously retrieve positive/negative meta-stereotypes about their own group, thereby activating the meta-stereotypes of their own group. Implicit activation methods can effectively activate individuals' positive/negative meta-stereotypes about their own group, but they do not control the trait categories of the activated meta-stereotypes. For example, in cognitive tasks, meta-stereotypes unrelated to cognitive abilities might be activated, which could merely occupy the participants' cognitive resources. This leads to negative effects whether positive or negative meta-stereotypes are activated. Moreover, in the assessment of whether implicit activation was successful, researchers used relatively indirect methods. The method of determining whether meta-stereotypes were successfully activated through physiological indicators of emotional measures has the drawback of lacking direct evidence to show which emotions are related to the activation of meta-stereotypes, and whether the activated meta-stereotypes are the sole cause of changes in participants' emotions. The direct questioning method, with only one question, is not credible in terms of reliability and validity.

4.2 Future Research Directions

In future research, first, we can seek to study groups that hold more positive meta-stereotypes. At the same time, research has shown that the characteristics of the meta-stereotypes used for activation can also affect the effects of activating meta-stereotypes with different valences. For example, previous researchers have pointed out that the resistance effect of negative meta-stereotypes often arises because the characteristic is related to enhancing group image and interests (Dong et al., 2022). In this series of studies, the activation method used by researchers requires implicit activation from the participants, which means that the type of meta-stereotype activated is uncontrollable. For cognitive tasks such as working memory, activating positive/negative meta-stereotypes related to cognitive abilities or personal abilities might yield new findings. The impact of activating meta-stereotypes with different effects may be influenced by the difficulty of meta-stereotype retrieval, individual internal resources, the degree of individualization of meta-stereotypes, and the social status of the group. These variables could all affect the influence of activated meta-stereotypes on individual cognitive abilities. In future research, these variables can be used as mediating or moderating variables to further explore the mechanisms by which activated meta-stereotypes affect cognitive processing abilities such as working memory.

Additionally, in terms of activation methods and testing, future researchers can develop more systematic and direct ways to test the effectiveness of meta-stereotype activation methods, or directly develop a set of questionnaires with generalizable reliability and validity.

5 CONCLUSION

Meta-stereotypes are the inherent beliefs held by in-group members about the potential evaluations that out-group members might have towards the in-group. Since there are evaluations with both positive and negative valences, there are meta-stereotypes with both positive and negative valences. These two types of meta-stereotypes may have different effects based on the principles of reciprocity and non-reciprocity. Only choking effect of simulating the positive meta-stereotype was found through N-back tasks of varying difficulty. Similarly, in conditions that activate negative meta-stereotypes, only the threat effect of activating negative meta-stereotypes has been found among the elderly and migrant children groups. This may be because previous studies have mainly focused on groups that generally hold more negative meta-stereotypes. Therefore, future research can be conducted across multiple groups. Moreover, the effects of activating meta-stereotypes are also influenced by the type of meta-stereotypes being activated. In the future, more specific and effective methods for activating meta-stereotypes can be

developed to differentiate the impact of different types of meta-stereotypes on working memory capacity.

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